

CLAIMS

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5 1. An apparatus for winding at least one web (1), on a winding roll (2), comprising at least a first roll (3), a second roll (4) and a third roll (5) parallel to one another and to said winding roll (2), said apparatus having a nominal winding position in which:

- said first and second rolls (3, 4) and said winding roll (2) are each in contact with said third roll (5);
- 10 - there is no contact between said first roll (3) and said second roll (4), between said first roll (3) and said winding roll (2) and between said second roll (4) and said winding roll (2);
- a first angle defined between a first half-plane delimited by the axis of said third roll (5) and comprising the axis (17) of said first roll (3) and a second half-plane delimited by the axis of said third roll (5) and comprising the axis (18) of said second roll (4) is smaller than 180° ;
- 15 - a second angle defined between a third half-plane delimited by the axis of said third roll (5) and comprising the axis of said winding roll (2) and a fourth half-plane delimited by the axis of said third roll (5) and comprising an intersection line is greater than 90° , said intersection line being defined as the intersection between the bisector plane of said first angle and the plane comprising the axis (17) of said first roll (3) and the axis (18) of said second roll (4).
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25 wherein said web (1) passes at least between said third roll (5) and said winding roll (2).

30 2. The apparatus according to claim 1, characterized in that said apparatus has further an open position in which said first, second and third rolls (3, 4, 5) are located out of the path of said web (1) in course of winding on said winding roll (2), the bearings of at least one roll among said first, second and third rolls (3, 4, 5) and said winding roll (2) being movable to enable the change of position from said apparatus between said open position and said nominal winding position.

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35 3. The apparatus according to claim 1 or 2, comprising means (19, 25, 27, 28, 29, 30) for causing said third roll (5) to position and align freely between said first and second rolls (3, 4) and said winding roll (2) when said apparatus is in said nominal winding position.

4. The apparatus according to any one of claims 1 to 3, characterized in that, in said nominal winding position, said second angle is substantially 180° .

5. The apparatus according to any one of claims 1 to 4, characterized in that, in said nominal winding position, said third half-plane is substantially vertical.

6. The apparatus according to any one of claims 1 to 5, characterized in that loading means (19) apply forces on the bearings of said third roll (5) so that the end regions of said third roll (5) abut said first and second rolls (3, 4) for any width of said winding roll (2) when said apparatus is in said nominal winding position.

7. The apparatus according to any one of claims 1 to 6, comprising means (11, 12, 19, 20, 21) for moving the bearings of said first, second and third rolls (3, 4, 5) along a common direction not perpendicular to said third half-plane and preferably parallel to said third half-plane, in order to adapt to the diameter of said winding roll (2) when said apparatus is in said nominal winding position, the bearings of said winding roll (2) being held fixed in said nominal winding position.

8. The apparatus according to claim 7, comprising interlocking means (13a, 14a, 15, 16) for selectively interlocking the bearings of said first and second rolls (3, 4) so that said first and second rolls (3, 4) are not free to move with respect to each other but together.

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9. The apparatus according to claim 7 or 8, comprising loading means (21, 23) for acting on the bearings of said first and second rolls (3, 4) with a force having a component parallel to said third half-plane and directed towards said winding roll (2) in order to press said third roll (5) against said winding roll (2) when said apparatus is in said nominal winding position.

10. The apparatus according to any one of claims 7 to 9, characterized in that, in said nominal winding position, the axis (31) of said third roll (5) is located at a higher level than the axis of said winding roll (2) and that the weight of said first, second and third rolls (3, 4, 5) is at least partly supported by said winding roll (2) via said third roll (5) whereby said third roll (5) exerts a pressure on said winding roll (2).

11. The apparatus according to claim 10, comprising loading means (21, 23) for acting on the bearings of said first and second rolls (3, 4) with a force having a

component parallel to said third half-plane and directed away from said winding roll (2) so that only a part of the weight of said first and second rolls (3, 4) is supported by said winding roll (2) when said apparatus is in said nominal winding position.

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12. The apparatus according to claim 10 or 11, comprising loading means (21, 23) for acting on the bearings of said first and second rolls (3, 4) with a force having a component parallel to said third half-plane and directed away from said winding roll (2) so that the pressure applied by third roll (5) on winding roll (2) is maximal in the middle region of said winding roll (2) and diminishes progressively towards its edges when said apparatus is in said nominal winding position.

13. The apparatus according to any one of claims 1 to 6, comprising means for moving the bearings of said winding roll (2) along a common direction not perpendicular to said third half-plane and preferably parallel to said third half-plane, in order to adapt to the diameter of said winding roll (2) when said apparatus is in said nominal winding position, the bearings of said first and second rolls (3, 4) being held fixed in said nominal winding position.

14. The apparatus according to claim 13, comprising loading means for acting on the bearings of said winding roll (2) with a force having a component parallel to said third half-plane and directed towards said third roll (5) in order to press said winding roll (2) against said third roll (5) backed up by said first and second rolls (3, 4) when said apparatus is in said nominal winding position.

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15. The apparatus according to claim 13 or 14, characterized in that, in said nominal winding position, the axis of said winding roll (2) is located at a higher level than the axis of said third roll (5) and in that the weight of said winding roll (2) is partly reported on said third roll (5) so that said third roll (5) exerts a reaction pressure on said winding roll (2).

16. The apparatus according to claim 15, comprising loading means for acting on the bearings of said winding roll (2) with a force having a component parallel to said third half-plane and directed away from said third roll (5) so that only a part of the weight of said winding roll (2) is reported on said third roll (5) when said apparatus is in said nominal winding position.

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17. The apparatus according to any one of claims 1 to 16, characterized in that for each roll among said first and second rolls (3, 4) coming in contact with said web

(N), it comprises means for selectively causing said roll either to rotate in a direction and at a tangential speed substantially corresponding to those of said web (1), or to act as an idle roll.

5 18. The apparatus according to any one of claim 1 to 17, comprising means for selectively causing at least said first or second roll (3, 4) either to act as an idle roll, or to rotate in a direction and at a speed whereby, when said third roll (5) is in direct contact with said first or second roll (3, 4), said third roll (5) is driven in rotation by friction in a direction and at a tangential speed substantially
10 corresponding to those of said web (1).

 19. The apparatus according to any one of claim 1 to 18, comprising means (18, 19, 20) for causing said third roll (5) to run along the circumference of said second roll (4) until said third roll (5) abuts also said first roll (3).

15 20. The apparatus according to any one of claims 1 to 19, characterized in that said third roll (5) is covered by an elastic material.

 21. The apparatus according to anyone of claims 1 to 20, characterized in that
20 the surface of said first roll (3) has a roughness R_t of less than 25 μm .

 22. The apparatus according to anyone of claims 1 to 21, characterized in that the surface of said second roll (4) has a roughness R_t of less than 25 μm .

25 23. The apparatus according to anyone of claims 1 to 22, characterized in that the surface of said first roll (3) is metallic and polished

 24. The apparatus according to anyone of claims 1 to 23, characterized in that
30 the surface of said second roll (4) is metallic and polished

 25. The apparatus according to any one of claims 1 to 24, characterized in that said first and second rolls (3, 4) have the same weight.

35 26. The apparatus according to any one of claims 1 to 25, characterized in that said first and second rolls (3, 4) have the same diameter.

27. The apparatus according to any one of claims 1 to 26, characterized in that the diameter of said first and second rolls (3, 4) is one to six times the diameter of said third roll (5).

28. The apparatus according to any one of claims 1 to 27, characterized in that said third roll (5) has a length of about 2 meters and a diameter of about 50 millimeters, said first roll (3) and said second roll (4) having a diameter of about 150 millimeters.

29. The apparatus according to any one of claims 1 to 28, characterized in that it further comprises a first set of rolls (8, 9) and a second set of rolls (6, 7), wherein said first set of rolls is located on one side and said second set of rolls is located on the other side of the path of said web (1) and wherein said first set of rolls (8, 9) and said second set of rolls (6, 7) are movable until the rolls (6, 7, 8, 9) of said first and second set of rolls contact said web (1), so that the rolls of said first set of rolls imbricate with the rolls of said second set of rolls with said web (1) being caused to form waves between them, said first and second set of rolls being located upstream with respect to said first, second and third rolls (3, 4, 5).

30. A method for winding at least one web (1) on a winding roll (2), using an apparatus according to any one of claims 1 to 29, wherein, in said nominal winding position, said web (1) passes between said third roll (5) and said winding roll (2), but neither between said second and third rolls (4, 5), nor between said first and third rolls (3, 5).

31. The method according to claim 30, comprising the step of:

(i) causing said apparatus to adopt said open position whereby said first, second and third rolls (3, 4, 5) are located at one side of the path of said web (1) towards said winding roll (2) and are preferably located relatively to one another as in said nominal winding position, but not in contact with said winding roll (2);

(ii) initiating the winding of said web (1) on said winding roll (2);

(iii) bringing said winding roll (2) and said first, second and third rolls (3, 4, 5) nearer until they adopt said nominal winding position.

32. A method for winding at least one web (1) on a winding roll (2), using an apparatus according to any one of claims 1 to 29, wherein, in said nominal winding position, said web (1) passes between said second and third rolls (4, 5), then between

said first and third rolls (3, 5) and finally between said third roll (5) and said winding roll (2).

33. The method according to claim 32, comprising the step of :

- 5 (i) causing said apparatus to adopt said open position whereby said first and second rolls (3, 4) are located at one side of the path of said web (1) towards said winding roll (2) and said third roll (5) is located on the other side of the path of said web (1) towards said winding roll (2);
- (ii) initiating the winding of said web (1) on said winding roll (2);
- 10 (iii) bringing said first, second and third rolls (3, 4) and said winding roll (2) nearer until they adopt said nominal winding position.

34. A method for winding at least one web (1) on a winding roll (2), using an apparatus according to any one of claims 1 to 29, wherein, in said nominal winding position, said web (1) passes between said first and third rolls (3, 5) and then between said third roll (5) and said winding roll (2), but not between said second roll (4) and said third roll (5).

35. The method according to claim 34, comprising the step of :

- 20 (i) causing said apparatus to adopt said open position whereby said first roll (3) is located on one side of the path of said web (1) towards said winding roll (2) and said second and third rolls (4, 5) are located on the other side of the path of said web (1) towards said winding roll (2);
- (ii) initiating the winding of said web (1) on said winding roll (2) ;
- 25 (iii) bringing said first, second and third rolls (3, 4, 5) and said winding roll (2) nearer until they adopt said nominal winding position.

36. The method according to claim 35, characterized in that step (iii) comprises two substeps consisting in:

- 30 (a) bringing said first, second and third rolls (3, 4, 5) nearer until a predetermined configuration in which said third roll (5) is in contact with said first roll (3) and said second roll (4), said third roll (5) not being in contact with said winding roll (2);
- (b) bringing said winding roll (2) and the unit formed by said first, second and third rolls (3, 4, 5) nearer until said third roll (5) is in contact with said winding roll (2).
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37. The method according to claim 36, characterized in that substep (a) is subdivided in two substeps consisting in :

(aa) bringing said first, second and third rolls (3, 4, 5) nearer until a predetermined configuration in which said first roll (3) and said second roll (4) are spaced of a predetermined distance and said third roll (5) is not in contact with said first roll (3) ;

(bb) bringing said third roll (5) nearer said first and second rolls (3, 4) until said third roll (5) is in contact with said first and second rolls.

38. The method according to claim 37, characterized in that in step (bb), said second roll (4) is caused to rotate and said third roll (5) is caused to run along the circumference of said second roll (4) whereby said second roll (4) causes said third roll (5) to rotate by friction driving in the direction and at a tangential speed corresponding substantially to those of said web (1).

39. Method according to any one of claims 31, 33 and 35 to 38, characterized in that in step (iii), each roll among said first and second rolls (3, 4) coming into contact with said web (1) is caused to rotate before contacting said web (1) in the direction and at a tangential speed corresponding substantially to those of said web (1).

40. Method according to any one of claims 31, 33 and 35 to 39, characterized in that in step (iii), said first roll (3) and said second roll (4) are caused to act as an idle roll before said third roll (5) and said winding roll (2) come into contact.

41. Method according to anyone of claims 31, 33 and 35 to 39, characterized in that in step (iii), said third roll (5) and said winding roll (2) are brought into contact by a relative displacement along a direction which is not perpendicular to said third half-plane.

42. Method according to any one of claims 30 to 41, characterized in that in said nominal winding position, said web (1) is caused to arrive on said first or second roll (3, 4) substantially perpendicularly to said third half-plane.